DOCUMENT RESUME

ED 165 130 CS 004 633

AUTHOR Gentner, Dedre
TITLE Semantic Integration at the Level of Verb Meaning. Technical Report No. 114.
INSTITUTION Bolt, Beranek and Newman, Inc., Cambridge, Mass.; Illinois Univ., Urbana. Center for the Study of Reading.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.; Public Health Service (DHEW), Washington, D.C.; Washington Univ., Seattle.
REPORT NO BBB-3826
PUB DATE Feb 79
CONTRACT 400-76-0116; USPHS-MH-10835-07
NOTE 39p.

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS *Association (Psychological); Associative Learning; *Cognitive Processes; Comprehension; Connected Discourse; Higher Education; *Language Research; *Reading Processes; Recall (Psychological); *Semantics; *Verbs

ABSTRACT

Twenty college students, ten each in the experimental and control groups, were the subjects of an experiment designed to demonstrate that integration of verb meanings occurs in connected discourse. Six paragraph-length stories, each of which included one or two critical sentences containing a general verb, were presented orally to the subjects. The experimental versions included an extra sentence or phrase whose meaning, when combined with the meaning of the general verb, was hypothesized to produce the meaning of a particular more specific verb. After hearing the stories, the subjects were administered a recall test containing four to eight sentences from each story, each with a missing word that the subjects were asked to fill in. The verbs of the critical sentences were always used. Results showed that subjects in the experimental group were more likely to recall the specific verb than were control subjects, that the effect of inserting material was stronger for some pairs than for others, and that the inserted material acted specifically to shift recall from the general verb to the particular specific verb predicted. (TJ)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED165130

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

CENTER FOR THE STUDY OF READING

Technical Report No. 114

Semantic Integration at the Level of Verb Meaning

Dedre Gentner
Bolt Beranek and Newman Inc.

February 1979

University of Illinois
at Urbana-Champaign
51 Gerty Drive
Champaign, Illinois 61820

BBN Report No. 3826

Bolt Beranek and Newman Inc.
50 Moulton Street
Cambridge, Massachusetts 02138

The research reported herein was supported in part by the National Institute of Education under Contract No. US-NIE-C-400-76-0116, in part by United States Public Health Service Predoctoral Traineeship USPHS MH 10835-07, and in part by the University of Washington, Seattle, Washington. I thank Elizabeth Loftus, Geoffrey Loftus, Colin MacLeod, and Andre Melztoff for their helpful comments on an earlier draft of this paper.

CS004633

Semantic Integration at the Level of Verb Meaning

Abstract

Subjects heard stories which contained general verbs (e.g., "give"). For half of the subjects, additional semantic information was included in each story. The hypothesis was that this additional information would combine with the meanings of the general verbs to produce the meanings of more specific verbs (e.g., "pay"). In a fill-in-the-blank recall task, subjects who had heard the extra material recalled these erroneous specific verbs often, while subjects who had not heard the extra material recalled the general verbs. These results are interpreted as providing evidence for integration of the semantic components of verbs from different parts of the passage.

Semantic Integration at the Level of Verb Meaning

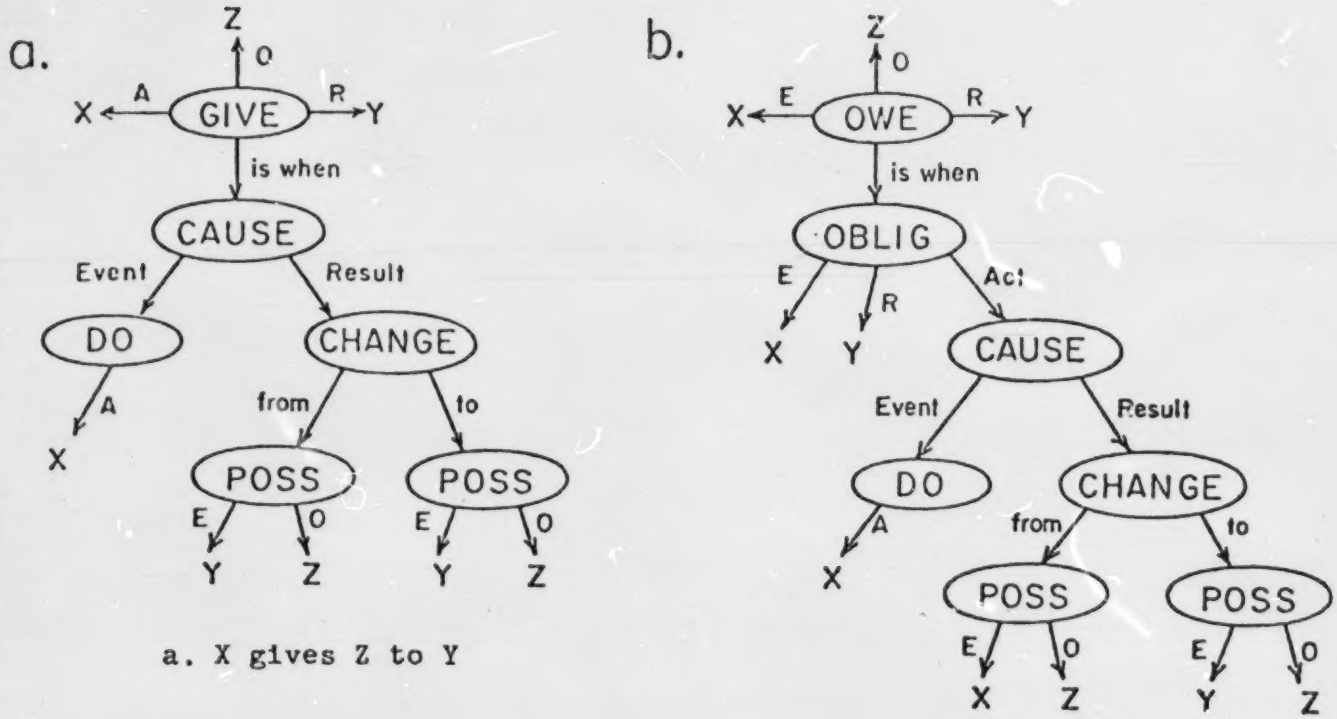
A great deal of recent work has focused on the phenomenon of semantic integration (Anderson & Ortony, 1975; Barclay, 1973; Bransford & Franks, 1971; Cofer, 1973; Dooling & Lachman, 1971; Kintsch, 1976; Loftus, 1975; Sulin & Dooling, 1974; Thorndyke, 1976). In a typical integration study, subjects are presented with meaningful information from different sources or at different times. It is commonly found that when the pieces of information are related in meaning, subjects are unable accurately to recall the information as presented and instead show effects attributable to integration of material from different sources.

Semantic integration appears to be a robust phenomenon, occurring over a wide variety of topic matters and presentation formats. However, relatively little is known about the process by which it occurs. Part of the reason for the lack of models of the integration process is that the representational structure of the materials themselves is not well understood; since models of knowledge structures are still in their infancy, it is not surprising that we lack precise descriptions of how those structures are combined in memory. However, one area in which reasonable well-specified models of meaning have been developed is that of verb meaning. Verb meanings have been analyzed by linguists (e.g., Chafe, 1970; Clark, 1970; Fillmore, 1971; Kartunnen, 1971; Lakoff, Note 3; McCawley, 1968; Postal, 1970;

and Talmy, 1975); by workers of artificial intelligence, notably Schank (1972, 1973); and by psychologists (e.g., Abrahamson, 1975; Fillenbaum & Rapoport, 1971; Gentner, 1975, Note 2; Miller & Johnson-Laird, 1976; Rumelhart & Levin, 1975; Stillings, 1975). This paper examines semantic integration at the level of individual verb meanings in an attempt to trace in this relatively well-analyzed area the processes by which integration occurs.

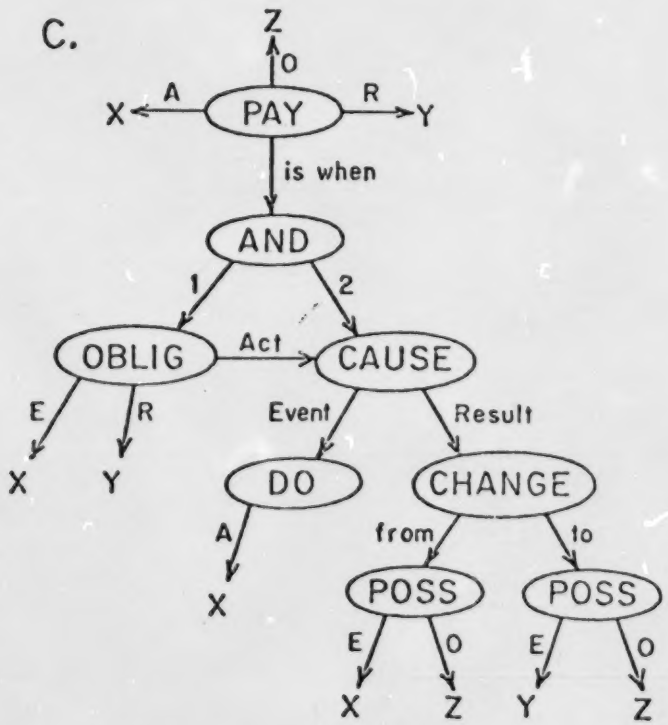
Though models of verb meaning differ from one another in detail, there is widespread agreement on the idea that verb meanings can be represented in terms of interrelated sets of subpredicates, such as CAUSE or CHANGE, which express semantic relationships. A typical English verb conveys several such relationships between the nouns in a sentence; most verbs also involve subpredicates which express relations between other subpredicates. There are many ways of notating these connected sets of subpredicates. Figure 1 shows verb representations in a network format.[1] For example, use of the verb give in a sentence, as shown in Figure 1a, conveys that the agent did something to cause the possession of the object to change from the agent to the recipient.

If in connected discourse the representations of individual sentences are combined into larger structures, then a person who has formed such a composite structure may be unable to recall the



a. X gives Z to Y

b. X owes Z (money) to Y



c. X pays Z (money) to Y

Figure 1. Semantic representations of give, owe, and pay. (Abbreviations used are: A - Agent; E - Experiencer; O - Object; R - Recipient; OBLIG - State of obligation; and POSS - State of possesion.)

original packaging of the structure into separate word representations. Such semantic integration among underlying subpredicates would be manifested as particular inaccuracies in memory for verbs. In the present study such semantic integrations are systematically produced. The basic idea is to contextually combine the meaning of a given verb with additional semantic information, thereby producing a structure identical to the meaning of another, more complex verb. The hypothesis is that the subjects hearing the extra material will falsely recall the verb which best fits the composite structure, rather than the verb actually presented.

The study utilizes pairs of general/specific verbs, in which the representation of the specific verb contains the entire representation of the more general verb as well as additional semantic information. Thus, on the representational level, the process is additive: the meaning components of the original verb are never contradicted; rather, other components are added. These components are either directly contained in the meaning of the added information or derived as inferences from the added information. An example which illustrates the basic method is the pair give/pay. The sentence

X gave Z to Y

conveys that there was a change in possession of the object Z from X to Y, and that X caused that transfer to take place. The

verb pay is a more specific verb than give: Normally, when we talk of someone paying, we mean that the person transferred possession of some money and also that there was an obligation to do so. Paying money is distinguished from giving money by this state of obligation (written OBLIG in Figure 1). Thus, if a state of obligation to transfer money is contextually joined to the act of giving money, the resulting meaning should be that of pay, as shown in Figure 1.

In a pilot study, subjects heard one of two versions of a paragraph and, after a two minute delay, wrote out the story, with instructions to be as accurate as possible (Gentner, 1975). Both versions described Sam requesting money from his friend Max and ended with the sentence

(a) Max finally gave Sam the money.

The two versions were identical except that the experimental story contained the information that Max owed Sam the money, while the control story did not. The verb owe conveys the state of obligation to transfer money, which is what distinguishes paying money from giving money. Thus, if integration of the meaning of owe with the meaning of give occurred in the experimental condition, these subjects should have recalled paid erroneously in sentence (a) to a greater extent than control subjects. The results of this pilot study were that 47% of the subjects who heard the owe sentence recalled paid or paid back;

none of the control subjects made these errors. These results support the idea that integration of verb meanings occurs in connected discourse. The present study replicates this phenomenon on a larger scale.

Method

Subjects

The subjects were 20 students (10 each in the experimental and control groups) enrolled in psychology courses at the University of California at San Diego, who received class credit for their participation. They were run in groups of three to six people.

Stimuli

Six paragraph-length stories were used as stimuli. Each story included one or two critical sentences containing general verbs. There were two versions of each story, a control version and an experimental version. The two versions were identical except in that the experimental version included an extra sentence or phrase whose meaning, when combined with the meaning of the general verb, was hypothesized to produce the meaning of a particular more specific verb. There were nine verb pairs, shown in Table 1 along with the inserted information for each pair. A sample story is given in Table 2. The complete stories appear in Gentner (Note 1).

Table 1

Stimuli

TEST SENTENCE OR CLAUSE (General Verb / Specific Verb)	INSERTED INFORMATION
1. He gave / paid Joe the money without complaining.	He owed Joe the money.
2. They are working on / painting the ballroom...	They are carrying whitewash and brushes; the walls later are wet.
3. ... he could but smile wanly and tell / warn them about the walls...	The walls have wet whitewash.
4. They liked to make / bake things together.	The things are fruitcakes, mincemeat, date bread, and fancy desserts.
5. He got / bought some muffler tape and went to work.	This occurred in a store.
6. ... he knew where he could get / borrow a tux.	His friend offered him use of a tux.
7. He decided to go ahead and take / borrow a tux.	His friend offered him use of a tux.
8. If she hadn't used / played it in the last year, it had to go.	The items are two violins, a piano, and a flute.
9. She gave / sold them the things she couldn't use.	By doing so, she made money.

Table 2

A Sample Story

Rosemary Kartovsky was pleased when the Chicago Symphony hired her away from the Boston Pops. She figured she could move everything in her camper, but first she had to go through her things and throw out the unnecessary items,

Two beat-up violins, an upright piano and a plastic flute went.

If she hadn't (used) it in the last year it had to go. Fortunately, she had some friends who were glad to get her castoffs. She (gave) them the things she couldn't use.

This way she made just enough money to pay for the gas on her trip.

The only thing that made her sad was parting with her toucan. She was used to hearing him sing along with her when she practiced.

As she drove out of the city limits, still reminding herself that it was for the best and that birds hate long trips, she heard a familiar croaking behind her. Sure enough, her pals had smuggled in the bird, and now she suddenly felt a hundred times better about life in Chicago.

Note. Parentheses denote critical verbs. Boxing denotes material inserted in the experimental condition. The predictions for the experimental group are used → played; gave → sold.

Procedure

Subjects were told that their task was to recall stories as accurately as possible. They then heard a set of three stories. This required about four minutes and was followed, after a delay of about 1 minute, by a fill-in-the-blank recall test. Four to eight sentences from each story were presented on a test page; each sentence had a missing word, which the subject was instructed to fill in. The verbs of the critical sentence(s) were always tested. In the other sentences, nouns or modifiers were tested, in order to disguise the purpose of the recall test. Only the recall of the verbs in the critical sentences was analyzed.

The procedure was repeated for the second group of three stories. The order of presentation of the two story sets and the order of stories within each set were varied randomly across groups of subjects. However, in any given set, the order of testing for stories was the same as the order of presentation.

Results

Verb recalls were scored as to whether the general verb, the predicted specific verb, or some other word was used. The results are shown in Table 3. Subjects who heard the inserted material were considerably more likely to recall the specific verb than subjects who did not. A mixed-measures analysis of

Table 3

Proportions of Response Types in Sentence Completions,

for Stories With and Without Inserted Material

Verb Pair	Correct General Verb	Predicted Specific Verb	Other
Working/painting			
With	0	.7	.3
Without	.8	0	.2
Got/bought			
With	.3	.5	.2
Without	.3	0	.7
Get/borrow			
With	.3	.4	.3
Without	.6	0	.4
Gave/sold			
With	.6	.4	0
Without	1.0	0	0
Take/borrow			
With	.1	.5	.4
Without	.1	.2	.7
Gave/paid			
With	.7	.2	.1
Without	.8	0	.2
Make/bake			
With	.3	.2	.5
Without	.2	0	.8
Used/played			
With	.9	.1	0
Without	.9	0	.1
Tell/warn			
With	.7	0	.3
Without	.6	0	.4
TOTAL			
With	.43	.33	.23
Without	.59	.02	.39

variance of the number of predicted specific verbs produced by each subject revealed that the effect of inserted material was significant [$F(1,18) = 24.13$, $p<.001$]. The effects of items and of the interaction between insertion and items were both significant, indicating that the effect of inserting material was stronger for some pairs than for others [$F(8,144) = 6.96$, $p<.001$; $F(8,144) = 3.03$, $p<.01$, respectively].

A Check for Bias

In order to conclude that the inserted material acts to create the representation of the predicted specific verb, it was necessary to rule out the possibility that the inserted material simply biased against the presented verb, thus causing a generalized increase in the number of substitutions in the experimental condition. To check this possibility, an analysis of variance like the one described above was performed for the total number of substitutions for each presented verb, other than the predicted verb. Here, the effect of insertion was not significant [$F(1,18) = 2.49$]. Thus, the inserted material acted specifically to shift recall from the general verb to the particular specific verb predicted. As in the analysis of predicted substitutions, the effect of items was significant [$F(8,144) = 8.96$, $p<.001$].

Item Effects

The strength of the substitution effect varied considerably across verb pairs, as shown in Table 3. To understand these differences, it is useful to divide the pairs into two classes, according to the kind of information that must be added to the general verb to create the specific verb. All of the general verbs used here are agentive verbs with a meaning roughly of the form CAUSE (ACTION(agent), RESULT). That is, these verbs convey that an animate agent did something that caused some result, generally a change-of-state of some kind. One way in which these semantic structures can be amplified to create a specific verb is for the action and/or the result to be further specified. The pairs working on/painting, make/bake, and used/played are all pairs in which the specific verb gives more information about either the actions performed or the result of the actions or both.

The situation is quite different with the pairs got/bought, gave/sold, gave/paid, get/borrow, and take/borrow (these last two used in the same story). As is typical in the domain of possession, the specific verbs used here do not amplify the meanings of the general verbs by specifying the actions performed; the precise nature of the actions is not usually of interest in describing a change of possession. Rather, the specific verbs convey that additional transfers or states of obligation are involved.

Action-result-specification. The substitution effect was strongest in the pair working-on/painting; 70% of the experimental subjects substituted painting for working-on. The story for this pair involved both action-specification and result-specification. To say that the men are working on the ballroom conveys that the men are performing some actions which will result in a change in the condition of the ballroom. In the experimental condition, the information was added that the men carried whitewash, brushes and rollers, and that subsequently the walls were covered with whitewash. Consider the meaning of the verb to paint: to cause, by means of an action-routine which involves a liquid and a brush (or roller), a change such that the liquid comes to be spread upon an object. To shift from working-on to painting, the experimental subjects had to connect the information about brushes and about wet walls with the working-on structure. There were then two converging inferences: from the fact that the walls are wet, the inference that the change-in-condition conveyed by working-on is the walls' being covered with whitewash; and from the presence of brushes and whitewash, the inference that the actions were painting-actions. This combination of action-routine and resulting change-of-state corresponds to the meaning of painting.

The pairs used/played and make/bake showed only very weak effects. Here, the added information specified either the

objects involved in the action or the objects resulting from the change-of-state, but not both. In the story for used/played, shown in Table 2, the experimental subjects learned that the objects used were musical instruments. The actions appropriate to musical instruments are playing-actions. However, no mention was made of any specific musical result (e.g., a sonata or mazurka) of performing these actions. In the pair make/bake, the objects resulting from the action (fruitcakes, date bread, etc.), were specified in the experimental condition, but no mention was made of the actions performed (e.g., mixing, turning on the oven), or of the objects involved in the actions (e.g., bowls, spoons). Thus, in each of these pairs only half of the more specific verb -- either the action or the resulting change-of-state was specified.

Addition of states or changes-of-state. The possession pairs -- got/bought, get/borrow, gave/sold, take/borrow, and gave/paid -- showed fairly strong effects. The story for get/borrow and take/borrow concerned Hank's need for a tuxedo, and experimental subjects were told that a friend had offered to let Hank use his tuxedo temporarily. This information combined with the notion of Hank's getting (or taking) a tuxedo to produce the meaning of borrowing a tuxedo: namely, assuming temporary possession of the tuxedo with the obligation to return it. Little inference was required beyond simply combining the

information given into a unified structure. In the pair gave/paid, as discussed earlier, the information that Max, the giver of money, owed the money was added in the experimental condition. The combined structure was then that of a person transferring money which he is obligated to transfer. This corresponds to the meaning of pay. The pairs got/bought and gave/sold both required some inference based on world knowledge. The experimental story for got/bought provides the extra information that the getting occurred in a store. Similarly, the experimental story for gave/sold, shown in Table 2, states that Rosemary made money when she gave some things to her friends. Knowledge of plausible money-making situations suggests that the friends gave Rosemary money in return. The combined set of transfers is captured by the word sell.

The pair tell/warn is a separate case. The difference between telling and warning lies in specification of the kind of message communicated. To warn guests about the walls is to tell them something roughly like: "Certain events involving the walls are possible, which if they occur will cause you harm." In the experimental story, subjects heard that the walls were wet with whitewash; thus, subjects might have inferred that Alexander's telling his guests about the walls referred to his warning them that brushing against the walls would prove harmful. In fact, no subjects replaced tell with warn.

Discussion

In the research presented here, the integration process was modeled on the assumption that verbs have structured componential representations which are evoked during comprehension, and which can combine with one another in discourse to yield larger meaning structures. General verbs appeared in stories along with semantic material which could combined with their meanings to form the meanings of more specific verbs. Subjects given this extra material produced the predicted specific verbs to a greater extent than subjects not given the material. In some cases, such as gave/paid, the shift from general to specific verb could be accounted for by simple combination of the semantic structures from various parts of the paragraph. In other cases, such as working-on/painting, additional inferences beyond the semantic information directly presented were required to produce the representation of the specific verb. However, in all cases, the shift was based on integration of meaning components from different parts of the paragraph. The results obtained are analogous to those of other studies in that elements originally presented separately are later recalled together. Here, meaning components presented in different words are later recalled in one word.

The present study probably underestimates the strength of the integration effect for two reasons. The first is that, in

every case, the word frequency of the specific verb is lower than that of the general verb for which it was substituted. The average word frequency was 50 per million for the specific verbs and 471 per million for the general verbs (Kucera & Francis, 1967). Normally, high-frequency words are better recalled than low frequency words (Kintsch, 1970); yet, here the result is that low-frequency words replace high-frequency words in recall. A second reason that these results may underestimate the amount of semantic integration is that there is an asymmetry between general and specific words which acts against the predicted shift. Use of a specific term implies that the general term is also true, but not the reverse; e.g., if the men painted the ballroom, then it is also true that they worked on the ballroom, whereas if the men worked on the ballroom, it is not necessarily true that they painted it. This asymmetry was important, for it allowed the construction of stories in which the meaning of the general verb was amplified but not contradicted by the inserted material. However, this meant that subjects who had performed the desired integration could still choose to use the general verb in recall (e.g., a subject who had stored that the men painted the ballroom could still report that the men worked on the ballroom). Thus, the general-specific shift is a conservative measure of the degree of semantic integration.

In modeling these effects, we are faced with the problem of where to draw the distinction between linguistic knowledge and world knowledge. Linguistic treatments of meaning seek to define systems in terms of which all word meanings can be specified. These systems are typically decompositional, based on representing word meanings analytically in terms of semantic features or components (e.g., Bierwisch, 1970; Katz & Fodor, 1963). Psychological applications of decompositional theories assume that a set of meaning components is substituted for each word during comprehension. This word-by-word substitution process is immediate and automatic and the set of components associated with a given word-sense is reasonably stable across tasks and contexts. In contrast, the world-knowledge approach emphasizes goal-sensitive rules of inference that relate propositions to other propositions (Kintsch, 1974; Stillings, 1975; Thorndyke, 1976). These active, high-level inferences are affected by both linguistic and non-linguistic context, including the goals of the listener and his understanding of the task. The world-knowledge approach emphasizes understanding of the overall situation; it is top-down, while the decompositional approach is bottom-up.

The approach taken here makes two assumptions concerning the nature of semantic processing. The first is that, although inferences and context-based expectations are undoubtedly an

important part of meaning processing, still these top-down processes must be based in part on the bottom-up knowledge derived from the individual word meaning. Therefore, to postulate that inferential processing occurs does not remove the necessity for modeling word meanings. The second assumption is that there is no sharp dividing line between world knowledge and semantic knowledge. Rather, the components that make up a word's meaning represent the "almost-inevitable-inferences" that follow from the use of the word, and are not different in nature from the conceptual components derivable from other sources of knowledge.

In addition to the almost-inevitable-inferences which are represented as components of meaning, other inferences may be made depending on the context, as was seen in some of the stories (e.g., in the got/bought passage). Anderson and Shiffin (1978) have shown that people reading a passage often instantiate: that is, they create models that are based on the text but are more detailed than the text. Given the word fish, a person might imagine a shark, for example. Anderson and Shiffin have shown that these instantiations are highly context-sensitive. Thus, in the representational scheme proposed here, the relatively context-independent inferences are included in the word's representation. More context-dependent inferences are derived from interactions between word meanings. Moreover, at times some

of the normal inferences may be contextually overridden; for example, in metaphorical extension, a word is used in a context in which not all of its normal meaning-structure is applicable (Gentner, 1975). Thus, the representation of the meaning of a verb is intended to capture the basic psychological meaning of the verb. This basic meaning is usually amplified, and sometimes partially suspended, by context and by other existing knowledge.

Barclay (1973) and Bransford, Barclay, and Franks (1972) have argued persuasively against a strictly linguistic account of the comprehension process, pointing out that comprehension frequently goes beyond the linguistic information presented. Further, the results of the Barclay (1973) sentence-memory experiment, in which subjects were found to integrate information such as, "The bear is to the left of the moose," and "The bear is to the right of the giraffe," disconfirm a binary-feature model of meaning. However, these results are compatible with a richer theory of meaning, such as the subpredicate model proposed here for verb meaning. Further, such demonstrations of the importance of integrative processing do not imply that word meaning is unimportant. On the contrary, the constructive inferences made by subjects in the Barclay (1973) and Bransford et al. (1972) experiments must have been based in part on their knowledge of the meanings of such words as left and right. The more clearly we specify discourse structure from the word level meanings at

every level up to the higher levels (story patterns, plan structure, etc.), the better our models of the interactions between levels. What is needed is a representational theory in terms of which integration among different word meanings, and between word meanings and other sources of knowledge, can be discussed. The analysis of verb meaning in terms of interrelated subpredicates may provide the beginnings of such a theory.

Reference Notes

1. Gentner, D. Evidence for the psychological reality of semantic components: The possession verbs. Unpublished doctoral dissertation, University of California, San Diego, 1974.

2. Gentner, D. Verb semantic structure: Effects on memory for nouns. Paper presented at the Meeting of the Psychonomic Society, St. Louis, Missouri, 1976.

3. Lakoff, G. Stative adjectives and verbs in English. Unpublished manuscript, 1966.

References

Abrahamson, A. A. Experimental analysis of the semantics of movements. In D. A. Norman & D. E. Rumelhart (Eds.), Explorations in cognition. San Francisco: W. H. Freeman, 1975.

Anderson, R. C., & Ortony, A. On putting apples into bottles: A problem of Polysemy. Cognitive Psychology, 1975, 7, 167-180.

Anderson, R. C., & Shifrin, Z. The meaning of words in context. To appear in R. J. Spiro, B. C. Bruce & W. F. Brewer (Eds.), Theoretical issues in reading comprehension. Hillsdale, N.J.: Erlbaum, 1978, in press.

Barclay, J. R. The role of comprehension in remembering sentences. Cognitive Psychology, 1973, 4, 229-254.

Bierwisch, M. Semantics. In T. Lyons (Ed.), New horizons in linguistics. Baltimore, Md.: Penguin Books, 1970. Pp. 166-184.

Bransford, J. D., Barclay, J. R., & Franks, J. J. Sentence memory: A constructive versus interpretive approach. Cognitive Psychology, 1972, 3, 193-209.

Bransford, J. D., & Franks, J. J. The abstraction of linguistic ideas. Cognitive Psychology, 1971, 2, 331-350.

Chafe, W. L. Meaning and the structure of language. Chicago: University of Chicago Press, 1970.

Clark, E. V. Locationals: A study of relations between "existential," "locative," and "possessive" constructions (Working Papers in Linguistic Universals No. 3). Stanford, Calif.: Stanford University, 1970.

Cofer, C. N. Constructive processes in memory. American Scientist, 1973, 61, 537-543.

Dooling, D. J., & Lachman, R. Effects of comprehension on retention of prose. Journal of Experimental Psychology, 1971, 88, 216-222.

Fillenbaum, S., & Rapoport, A. Structures in the subjective lexicon. New York: Academic Press, 1971.

Fillmore, C. J. Verbs of judging: An exercise in the semantic description. In C. J. Fillmore & D. T. Langendoen (Eds.), Studies in linguistic semantics. New York: Holt, Rinehart and Winston, 1971. Pp. 273-296.

Gentner, D. Evidence for the psychological reality of semantic components: The verbs of possession. In D. A. Norman & D. E. Rumelhart (Eds.), Explorations in cognition. San Francisco: W. H. Freeman, 1975.

Kartunnen, L. Implicative verbs. Language, 1971, 47, 340-358.

Katz, J. J., & Fodor, J. A. The structure of a semantic theory. Language, 1963, 39, 170-210.

Kintsch, W. Models for free recall and recognition. In D. A. Norman (Ed.), Models of human memory. New York: Academic Press, 1970.

Kintsch, W. The representation of meaning in memory. Hillsdale, N.J.: Erlbaum, 1974.

Kintsch, W. Memory for prose. In C. N. Cofer (Ed.), The structure of human memory. San Francisco: W. H. Freeman, 1976.

Kucera, H., & Francis, W. N. Computational analysis of present-day American English. Providence, R.I.: Brown University Press, 1967.

Loftus, E. Leading questions and the eyewitness report. Cognitive Psychology, 1975, 7, 560-572.

McCawley, J. D. The role of semantics in a grammar. In E. Bach & R. T. Harms (Eds.), Universals in linguistic theory. New York: Holt, Rinehart and Winston, 1968.

Miller, G. A., & Johnson-Laird, P. N. Language and perception. Cambridge, Mass.: Belknap Press, 1976.

Norman, D. A., & Rumelhart, D. E. Explorations in cognition. San Francisco: W. H. Freeman, 1975.

Postal, P. M. On the surface verb "remind." Linguistic Inquiry, 1970, 1, 37-120.

Rumelhart, D. E., & Levin, J. A. A language comprehension system. In D. A. Norman & D. E. Rumelhart, Explorations in cognition. San Francisco: W. H. Freeman, 1975.

Schank, R. C. Conceptual dependency: A theory of natural language understanding. Cognitive Psychology, 1972, 3, 552-631.

Schank, R. C. Identification of conceptualizations underlying natural language. In R. C. Schank & K. M. Colby (Eds.), Computer models of thought and language. San Francisco: W. H. Freeman, 1973.

Stillings, N. A. Meaning rules and systems of inference for verbs of transfer and possession. Journal of Verbal Learning and Verbal Behavior, 1975, 14, 453-470.

Sulin, R. A., & Dooling, D. J. Intrusion of a thematic idea in retention of prose. Journal of Experimental Psychology, 1974, 103, 255-262.

Talmy, L. Semantics and syntax of motion. In J. P. Kimball (Ed.), Syntax and semantics (Vol. 4). New York: Academic Press, 1975.

Thorndyke, P. A. The role of inference in discourse comprehension. Journal of Verbal Learning and Verbal Behavior, 1976, 15, 437-446.

Footnotes

1. The representational format shown here was developed at the University of California at San Diego in a seminar headed by David E. Rumelhart and attended by Adele A. Abrahamson, Danielle Dubois, Dedre Gentner, James A. Levin and Stephen E. Palmer. The system is explained in detail in Norman and Rumelhart (1975).
2. Miller and Johnson-Laird (1976) make the similar point that a theory of meaning "should represent meanings of words and sentences in compatible form" and "should allow for the differing significance of sentences depending on their context..." (Miller & Johnson-Laird, 1976, p. 706)

CENTER FOR THE STUDY OF READING

READING EDUCATION REPORTS

No. 1: Durkin, D. Comprehension Instruction--Where Are You?, October 1977. (ERIC Document Reproduction Service No. ED 146 566, 14p., HC-$1.67, MF-$.83)

No. 2: Asher, S. R. Sex Differences in Reading Achievement, October 1977. (ERIC Document Reproduction Service No. ED 146 567, 30p., HC-$2.06, MF-$.83)

No. 3: Adams, M. J., Anderson, R. C., & Durkin, D. Beginning Reading: Theory and Practice, November 1977.

No. 4: Jenkins, J. R., & Pany, D. Teaching Reading Comprehension in the Middle Grades, January 1978.

No. 5: Bruce, B. What Makes a Good Story?, June 1978.

No. 6: Anderson, T. H. Another Look at the Self-Questioning Study Technique, September 1978.

CENTER FOR THE STUDY OF READING

TECHNICAL REPORTS

* Available only through ERIC

*No. 1: Halff, H. M. Graphical Evaluation of Hierarchical Clustering Schemes, October 1975. (ERIC Document Reproduction Service No. ED 134 926, 11p., HC-$1.67, MF-$.83)

*No. 2: Spiro, R. J. Inferential Reconstruction in Memory for Connected Discourse, October 1975. (ERIC Document Reproduction Service No. ED 136 187, 81p., HC-$4.67, MF-$.83)

*No. 3: Goetz, E. T. Sentences in Lists and in Connected Discourse, November 1975. (ERIC Document Reproduction Service No. ED 134 927, 75p., HC-$3.50, MF-$.83)

*No. 4: Alessi, S. M., Anderson, T. H., & Biddle, W. B. Hardware and Software Considerations in Computer Based Course Management, November 1975. (ERIC Document Reproduction Service No. ED 134 928, 21p., HC-$1.67, MF-$.83)

*No. 5: Schallert, D. L. Improving Memory for Prose: The Relationship Between Depth of Processing and Context, November 1975. (ERIC Document Reproduction Service No. ED 134 929, 37p., HC-$2.06, MF-$.83)

*No. 6: Anderson, R. C., Goetz, E. T., Pichert, J. W., & Halff, H. M. Two Faces of the Conceptual Peg Hypothesis, January 1976. (ERIC Document Reproduction Service No. ED 134 930, 29p., HC-$2.06, MF-$.83)

*No. 7: Ortony, A. Names, Descriptions, and Pragmatics, February 1976. (ERIC Document Reproduction Service No. ED 134 931, 25p., HC-$1.67, MF-$.83)

No. 8: Mason, J. M. Questioning the Notion of Independent Processing Stages in Reading, February 1976. (Journal of Educational Psychology, 1977, 69, 288-297)

*No. 9: Siegel, M. A. Teacher Behaviors and Curriculum Packages: Implications for Research and Teacher Education, April 1976. (ERIC Document Reproduction Service No. ED 134 932, 42p., HC-$2.06, MF-$.83)

*No. 10: Anderson, R. C., Pichert, J. W., Goetz, E. T., Schallert, D. L., Stevens, K. V., & Trollip, S. R. Instantiation of General Terms, March 1976. (ERIC Document Reproduction Service No. ED 134 933, 30p., HC-$2.06, MF-$.83)

*No. 11: Armbruster, B. B. Learning Principles from Prose: A Cognitive Approach Based on Schema Theory, July 1976. (ERIC Document Reproduction Service No. ED 134 934, 48p., HC-$2.06, MF-$.83)

*No. 12: Anderson, R. C., Reynolds, R. E., Schallert, D. L., & Goetz, E. T. Frameworks for Comprehending Discourse, July 1976. (ERIC Document Reproduction Service No. ED 134 935, 33p., HC-$2.06, MF-$.83)

No. 13: Rubin, A. D., Bruce, B. C., & Brown, J. S. A Process-Oriented Language for Describing Aspects of Reading Comprehension, November 1976. (ERIC Document Reproduction Service No. ED 136 188, 41p., HC-$2.06, MF-$.83)

No. 14: Pichert, J. W., & Anderson, R. C. Taking Different Perspectives on a Story, November 1976. (ERIC Document Reproduction Service No. ED 134 936, 30p., HC-$2.06, MF-$.83)

No. 15: Schwartz, R. M. Strategic Processes in Beginning Reading, November 1976. (ERIC Document Reproduction Service No. ED 134 937, 19p., HC-$1.67, MF-$.83)

No. 16: Jenkins, J. R., & Pany, D. Curriculum Biases in Reading Achievement Tests, November 1976. (ERIC Document Reproduction Service No. ED 134 938, 24p., HC-$1.67, MF-$.83)

No. 17: Asher, S. R., Hymel, S., & Wigfield, A. Children's Comprehension of High- and Low-Interest Material and a Comparison of Two Cloze Scoring Methods, November 1976. (ERIC Document Reproduction Service No. ED 134 939, 32p., HC-$2.06, MF-$.83)

No. 18: Brown, A. L., Smiley, S. S., Day, J. D., Townsend, M. A. R., & Lawton, S. C. Intrusion of a Thematic Idea in Children's Comprehension and Retention of Stories, December 1976. (ERIC Document Reproduction Service No. ED 136 189, 39p., HC-$2.06, MF-$.83)

No. 19: Kleiman, G. M. The Prelinguistic Cognitive Basis of Children's Communicative Intentions, February 1977. (ERIC Document Reproduction Service No. ED 134 940, 51p., HC-$3.50, MF-$.83)

No. 20: Kleiman, G. M. The Effect of Previous Context on Reading Individual Words, February 1977. (ERIC Document Reproduction Service No. ED 134 941, 76p., HC-$4.67, MF-$.83)

No. 21: Kane, J. H., & Anderson, R. C. Depth of Processing and Interference Effects in the Learning and Remembering of Sentences, February 1977. (ERIC Document Reproduction Service No. ED 134 942, 29p., HC-$2.06, MF-$.83)

No. 22: Brown, A. L., & Campione, J. C. Memory Strategies in Learning: Training Children to Study Strategically, March 1977. (ERIC Document Reproduction Service No. ED 136 234, 54p., HC-$3.50, MF-$.83)

No. 23: Smiley, S. S., Oakley, D. D., Worthen, D., Campione, J. C., & Brown, A. L. Recall of Thematically Relevant Material by Adolescent Good and Poor Readers as a Function of Written Versus Oral Presentation, March 1977. (ERIC Document Reproduction Service No. ED 136 235, 23p., HC-$1.67, MF-$.83)

No. 24: Anderson, R. C., Spiro, R. J., & Anderson, M. C. Schemata as Scaffolding for the Representation of Information in Connected Discourse, March 1977. (ERIC Document Reproduction Service No. ED 136 236, 18p., HC-$1.67, MF-$.83)

No. 25: Pany, D., & Jenkins, J. R. Learning Word Meanings: A Comparison of Instructional Procedures and Effects on Measures of Reading Comprehension with Learning Disabled Students, March 1977. (ERIC Document Reproduction Service No. ED 136 237, 34p., HC-$2.06, MF-$.83)

No. 26: Armbruster, B. B., Stevens, R. J., & Rosenshine, B. Analyzing Content Coverage and Emphasis: A Study of Three Curricula and Two Tests, March 1977. (ERIC Document Reproduction Service No. ED 136 238, 22p., HC-$1.67, MF-$.83)

No. 27: Ortony, A., Reynolds, R. E., & Arter, J. A. Metaphor: Theoretical and Empirical Research, March 1977. ERIC Document Reproduction Service No. ED 137 752, 63p., HC-$3.50, MF-$.83)

No. 28: Ortony, A. Remembering and Understanding Jabberwocky and Small-Talk, March 1977. (ERIC Document Reproduction Service No. ED 137 753, 36p., HC-$2.06, MF-$.83)

No. 29: Schallert, D. L., Kleiman, G. M., & Rubin, A. D. Analysis of Differences Between Oral and Written Language, April 1977. (ERIC Document Reproduction Service No. ED 144 038, 33p., HC-$2.06, MF-$.83)

No. 30: Goetz, E. T., & Osborn, J. Procedures for Sampling Texts and Tasks in Kindergarten through Eighth Grade, April 1977. (ERIC Document Reproduction Service No. ED 146 565, 80p., HC-$4.67, MF-$.83)

No. 31: Nash-Webber, B. Anaphora: A Cross-Disciplinary Survey, April 1977. (ERIC Document Reproduction Service No. ED 144 039, 43p., HC-$2.06, MF-$.83)

No. 32: Adams, M. J., & Collins, A. A Schema-Theoretic View of Reading Comprehension, April 1977. (ERIC Document Reproduction Service No. ED 146 565, 80p., HC-$4.67, MF-$.83)

No. 33: Huggins, A. W. F. Syntactic Aspects of Reading Comprehension, April 1977. (ERIC Document Reproduction Service No. ED 142 972, 68p., HC-$3.50, MF-$.83)

No. 34: Bruce, B. C. Plans and Social Actions, April 1977. (ERIC Document Reproduction Service No. ED 149 328, 45p., HC-$2.06, MF-$.83)

No. 35: Rubin, A. D. Comprehension Processes in Oral and Written Language, April 1977. (ERIC Document Reproduction Service No. ED 150 550, 61p., HC-$3.50, MF-$.83)

No. 36: Nash-Webber, B., & Reiter, R. Anaphora and Logical Form: On Formal Meaning Representations for Natural Language, April 1977. (ERIC Document Reproduction Service No. ED 142 973, 42p., HC-$2.06, MF-$.83)

No. 37: Adams, M. J. Failures to Comprehend and Levels of Processing in Reading, April 1977.

No. 38: Woods, W. A. Multiple Theory Formation in High-Level Perception, April 1977. (ERIC Document Reproduction Service No. ED 144 020, 58p., HC-$3.50, MF-$.83)

No. 40: Collins, A., Brown, J. S., & Larkin, K. M. Inference in Text Understanding, December 1977. (ERIC Document Reproduction Service No. ED 150 547, 48p., HC-$2.06, MF-$.83)

No. 41: Anderson, R. C., & Pichert, J. W. Recall of Previously Unrecallable Information Following a Shift in Perspective, April 1977. (ERIC Document Reproduction Service No. ED 142 974, 37p., HC-$2.06, MF-$.83)

No. 42: Mason, J., Osborn, J., & Rosenshine, B. A Consideration of Skill Hierarchy Approaches to the Teaching of Reading, December 1977. (ERIC Document Reproduction Service No. ED 150 549, 176p., HC-$10.03, MF-$.83)

No. 43: Collins, A., Brown, A. L., Morgan, J. L., & Brewer, W. F. The Analysis of Reading Tasks and Texts, April 1977.

No. 44: McClure, E. Aspects of Code-Switching in the Discourse of Bilingual Mexican-American Children, April 1977. (ERIC Document Reproduction Service No. ED 142 975, 39p., HC-$2.06, MF-$.83)

No. 45: Schwartz, R. M. Relation of Context Utilization and Orthographic Automaticity in Word Identification, May 1977.

No. 46: Anderson, R. C., Stevens, K. C., Shifrin, Z., & Osborn, J. Instantiation of Word Meanings in Children, May 1977. (ERIC Document Reproduction Service No. ED 142 976, 22p., HC-$1.67, MF-$.83)

No. 47: Brown, A. L. Knowing When, Where, and How to Remember: A Problem of Metacognition, June 1977. (ERIC Document Reproduction Service No. ED 146 562, 152p., HC-$8.69, MF-$.83)

No. 48: Brown, A. L., & DeLoache, J. S. Skills, Plans, and Self-Regulation, July 1977. (ERIC Document Reproduction Service No. ED 144 040, 66p., HC-$3.50, MF-$.83)

No. 49: Goetz, E. T. Inferences in the Comprehension of and Memory for Text, July 1977. (ERIC Document Reproduction Service No. ED 150 548, 97p., HC-$4.67, MF-$.83)

No. 50: Anderson, R. C. Schema-Directed Processes in Language Comprehension, July 1977. (ERIC Document Reproduction Service No. ED 142 977, 33p., HC-$2.06, MF-$.83)

No. 51: Brown, A. L. Theories of Memory and the Problems of Development: Activity, Growth, and Knowledge, July 1977. (ERIC Document Reproduction Service No. ED 144 041, 59p., HC-$3.50, MF-$.83)

No. 52: Morgan, J. L. Two Types of Convention in Indirect Speech Acts, July 1977.

No. 53: Brown, A. L., Smiley, S. S., & Lawton, S. C. The Effects of Experience on the Selection of Suitable Retrieval Cues for Studying from Prose Passages, July 1977. (ERIC Document Reproduction Service No. ED 144 042, 30p., HC-$2.06, MF-$.83)

No. 54: Fleisher, L. S., & Jenkins, J. R. Effects of Contextualized and Decontextualized Practice Conditions on Word Recognition, July 1977. (ERIC Document Reproduction Service No. ED 144 043, 37p., HC-$2.06, MF-$.83)

No. 55: Jenkins, J. R., & Larson, K. Evaluating Error Correction Procedures for Oral Reading, June 1978.

No. 56: Anderson, T. H., Standiford, S. N., & Alessi, S. M. Computer Assisted Problem Solving in an Introductory Statistics Course, August 1977. (ERIC Document Reproduction Service No. ED 146 563, 26p., HC-$2.06, MF-$.83)

No. 57: Barnitz, J. Interrelationship of Orthography and Phonological Structure in Learning to Read, August 1977. (ERIC Document Reproduction Service No. ED 150 546, 62p., HC-$3.50, MF-$.83)

No. 58: Mason, J. M. The Role of Strategy in Reading in the Mentally Retarded, September 1977.

No. 59: Mason, J. M. Reading Readiness: A Definition and Skills Hierarchy from Preschoolers' Developing Conceptions of Print, September 1977.

No. 60: Spiro, R. J., & Esposito, J. J. Superficial Processing of Explicit Inferences in Text, December 1977. (ERIC Document Reproduction Service No. ED 150 545, 27p., HC-$2.06, MF-$.83)

No. 65: Brewer, W. F. Memory for the Pragmatic Implications of Sentences, October 1977. (ERIC Document Reproduction Service No. ED 146 564, 27p., HC-$2.06, MF-$.83)

No. 66: Brown, A. L., & Smiley, S. S. The Development of Strategies for Studying Prose Passages, October 1977.

No. 68: Stein, N. L., & Nezworski, T. The Effects of Organization and Instructional Set on Story Memory, January 1978. (ERIC Document Reproduction Service No. ED 149 327, 41p., HC-$2.06, MF-$.83)

No. 69: Stein, N. L. How Children Understand Stories: A Developmental Analysis, March 1978.

No. 76: Thieman, T. J., & Brown, A. L. The Effects of Semantic and Formal Similarity on Recognition Memory for Sentences in Children, November 1977. (ERIC Document Reproduction Service No. ED 150 551, 26p., HC-$2.06, MF-$.83)

No. 77: Nash-Webber, B. L. Inference in an Approach to Discourse Anaphora, January 1978. (ERIC Document Reproduction Service No. ED 150 552, 30p., HC-$2.06, MF-$.83)

No. 78: Gentner, D. On Relational Meaning: The Acquisition of Verb Meaning, December 1977. (ERIC Document Reproduction Service No. ED 149 325, 46p., HC-$2.06, MF-$.83)

No. 79: Royer, J. M. Theories of Learning Transfer, January 1978. (ERIC Document Reproduction Service No. ED 149 326, 55p., HC-$3.50, MF-$.83)

No. 80: Arter, J. A., & Jenkins, J. R. Differential Diagnosis-Prescriptive Teaching: A Critical Appraisal, January 1978. (ERIC Document Reproduction Service No. ED 150 578, 104p., HC-$6.01, MF-$.83)

No. 81: Shoben, E. J. Choosing a Model of Sentence Picture Comparisons: A Reply to Catlin and Jones, February 1978. (ERIC Document Reproduction Service No. ED 150 577, 30p., HC-$2.06, MF-$.83)

No. 82: Steffensen, M. S. Bereiter and Engelmann Reconsidered: The Evidence from Children Acquiring Black English Vernacular, March 1978.

No. 83: Reynolds, R. E., Standiford, S. N., & Anderson, R. C. Distribution of Reading Time when Questions are Asked about a Restricted Category of Text Information, April 1978.

No. 84: Baker, L. Processing Temporal Relationships in Simple Stories: Effects of Input Sequence, April 1978.

No. 85: Mason, J. M., Knisely, E., & Kendall, J. Effects of Polysemous Words on Sentence Comprehension, May 1978.

No. 86: Anderson, T. H., Wardrop, J. L., Hively, W., Muller, K. E., Anderson, R. I., Hastings, C. N., & Frederiksen, J. Development and Trial of a Model for Developing Domain Referenced Tests of Reading Comprehension, May 1978.

No. 87: André, M. E. D. A., & Anderson, T. H. The Development and Evaluation of a Self-Questioning Study Technique, June 1978.

No, 88: Bruce, B., & Newman, D. Interacting Plans, June 1978.

No. 89: Bruce, B., Collins, A., Rubin, A. D., & Gentner, D. A Cognitive Science Approach to Writing, June 1978.

No. 90: Asher, S. T. Referential Communication, June 1978.

No. 91: Royer, J. M., & Cunningham, D. J. On the Theory and Measurement of Reading Comprehension, June 1978.

No. 92: Mason, J. M., & Kendall, J. R. Facilitating Reading Comprehension through Text Structure Manipulation, June 1978.

No. 93: Ortony, A., Schallert, D. L., Reynolds, R. E., & Antos, S. J. Interpreting Metaphors and Idioms: Some Effects of Context on Comprehension, July 1978.

No. 94: Brown, A. L., Campione, J. C., & Barclay, C. R. Training Self-Checking Routines for Estimating Test Readiness: Generalization from List Learning to Prose Recall, July 1978.

No. 95: Reichman, R. Conversational Coherency, July 1978.

No. 96: Wigfield, A., & Asher, S. R. Age Differences in Children's Referential Communication Performance: An Investigation of Task Effects, July 1978.

No. 97: Steffensen, M. S., Jogdeo, C., & Anderson, R. C. A Cross-Cultural Perspective on Reading Comprehension, July 1978.

No. 98: Green, G. M. Discourse Functions of Inversion Construction, July 1978.

No. 99: Asher, S. R. Influence of Topic Interest on Black Children and White Children's Reading Comprehension, July 1978.

No. 100: Jenkins, J. R., Pany, D., & Schreck, J. Vocabulary and Reading Comprehension: Instructional Effects, August 1978.

No. 101: Shoben, E. J., Rips, L. J., & Smith, E. E. Issues in Semantic Memory: A Response to Glass and Holyoak, August 1978.

No. 102: Baker, L., & Stein, N. L. The Development of Prose Comprehension Skills, September 1978.

No. 103: Fleisher, L. S., Jenkins, J. R., & Pany, D. Effects on Poor Readers' Comprehension of Training in Rapid Decoding, September 1978.

No. 104: Anderson, T. H. Study Skills and Learning Strategies, September 1978.

No. 105: Ortony, A. Beyond Literal Similarity, October 1978.

No. 106: Durkin, D. What Classroom Observations Reveal about Reading Comprehension Instruction, October 1978.

No. 107: Adams, M. J. Models of Word Recognition, October 1978.

No. 108: Reder, L. M. Comprehension and Retention of Prose: A Literature Review, November 1978.

No. 109: Wardrop, J. L., Anderson, T. H., Hively, W., Anderson, R. I., Hastings, C. N., & Muller, K. E. A Framework for Analyzing Reading Test Characteristics, December 1978.

No. 110: Tirre, W. C., Manelis, L., & Leicht, K. L. The Effects of Imaginal and Verbal Strategies on Prose Comprehension in Adults, December 1978.

No. 111: Spiro, R. J., & Tirre, W. C. Individual Differences in Schema Utilization During Discourse Processing, January 1979.

No. 112: Ortony, A. Some Psycholinguistic Aspects of Metaphor, January 1979.

No. 113: Antos, S. J. Processing Facilitation in a Lexical Decision Task. January 1979.

No. 114: Gentner, D. Semantic Integration at the Level of Verb Meaning, February 1979.